Renewable Energy Question #25: Has MI, or have other jurisdictions, incentivized dispatchable renewable sources such as biomass compared to intermittent renewable generation? Why or why not?

There has been no state that has set renewable energy policy incentives to differentiate between dispatchable and intermittent variable renewable generation. The reasons for this can be found in the in the goals for state renewables policy, energy markets generally, and in the research on variable energy integration.

State goals: States have set renewable energy goals and procured supplies that meet these goals without including the distinction of "dispatchable" in the definitions or targets for the renewable energy procurement. States instead have sought to include the characteristics that bring benefits to the state. As the discussions below of energy markets and research on the subject show, there is little or no distinction between renewable energy that is dispatchable and renewable energy that is intermittent.

Markets: All energy has some variability. The costs of variability of generators are generally not investigated and assigned different values. The definition of "Dispatchable" in the Midwest ISO includes wind generation that responds to instructions to turn down when conditions on the grid merit such instructions. This lowers the costs to operate the grid, and, importantly, does not include an incentive.

Grid operators maintain reliability while providing consumers with high levels of variable renewable energy by using operational adjustments and wind forecasts. For an excellent summary of the widespread use of these tools amongst Independent System Operators, see the August 2011 ISO/RTO Council Briefing Paper "Variable Energy Resources, System Operations and Wholesale Markets" http://www.isorto.org/atf/cf/%7B5B4E85C6-7EAC-40A0-8DC3-003829518EBD%7D/IRC_VER-BRIEFING_PAPER-AUGUST_2011.PDF

UCS has collected experiences of utilities in the Midwest and the West that demonstrate the ability of power systems to operate with high levels of variable renewable energy. In 2012, wind power provided 24 percent of South Dakota's annual electricity needs, 24 percent in Iowa, 15 percent in North Dakota, 14 percent in Minnesota, and more than 10 percent in five more states (EIA 2013).

Xcel Energy—the largest retail provider of wind power in the U.S. in 2011—set a new U.S. record on April 15, 2012 by generating more than 57 percent of the electricity needed to supply its customers in Colorado on a night when the winds were strong and electricity demand was low (Xcel 2012). "We are very proud of this accomplishment," said Steve Mudd, product manager for Xcel Energy's Windsource program. "Achieving 57 percent is amazing, and it has taken a lot of hard work to reach such a record. But this is just one more milestone, and we are continually working to improve."

According to Mudd, these world records also help dismiss the long-held criticism of wind's unreliability. "What each of our world records shows is that while wind is intermittent, it can be relied upon. And as we continue to bring more wind onto our system, we hope to become smarter and more efficient."

Renewable energy supplied about 25 percent of Germany's electricity in 2012, with more than half coming from wind and solar (Federal Ministry for the Environment 2012). On May 8, 2012, wind and solar reached a record 60 percent of total electricity use in Germany during a sunny afternoon with low demand (NREL 2012). (Germany is the world leader in installed solar capacity, with 24 GW as of 2011, and is among the world leaders in wind capacity, with 29 GW as of 2011.)

In 2012, wind supplied 30 percent of Denmark's annual electricity use, 17 percent of Portugal's, and 16 percent of Spain's. (See full set of data in Clemmer, S. 2013. *Ramping Up Renewables*. Cambridge, MA: Union of Concerned Scientists. April.)

Research on the subject: over many studies of many regions with a wide range of renewable energy scenarios, the impact of the variability appears to be approximately half a cent per kilowatthour of wind energy. As is the case in the actual markets, there is little consensus on what the costs are for the variability and behaviors of conventional generation. The research finds that there is a greater stress in the scheduling practice of many generators to commit and sell energy for 18 hours per day, a practice known as "block schedule." The research and real-world observation suggests the combined impact of all these generators shutting down at the end of the 18-hour day imposes a greater challenge for grid operators than the uncorrelated variation in wind generation across the Midwest. See link to 2-page fact sheet from National Renewable Energy Lab: http://www.nrel.gov/docs/fy12osti/56235.pdf

Detailed simulations by grid operators, utilities and other experts in the United States have found that the grids in the Eastern and Western halves of the country can accommodate up to 30 percent of total electricity from wind, and another 5 percent from solar energy in the West (EnerNex 2010, GE Energy 2010). Using energy storage to balance out fluctuations in these resources was found to be helpful but not necessary, and not always economic. These simulations showed that significant new transmission investment would be required, along with changes to how the grid is operated today. One of these studies found that the additional transmission costs needed to increase wind generation to 20-30 percent of electricity use in the Eastern half the country by 2024 would be 2-5 percent of total annual costs (EnerNex 2010). However, the study also showed that most or all of the additional transmission and integration costs would be offset by lower costs for operating coal and natural gas plants.